

## In-Process Monitoring of Additive Manufacturing, Phase I

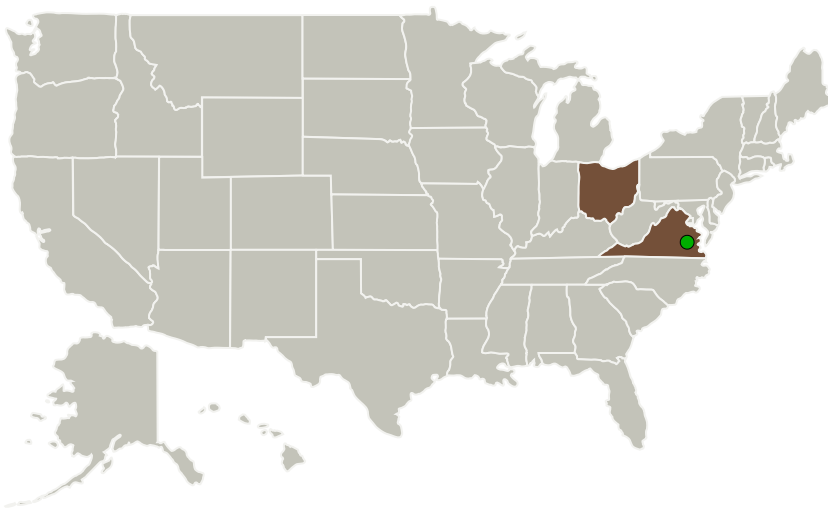
Completed Technology Project (2014 - 2014)



## Project Introduction

The key innovation in this project is the implementation of an Imaging Fourier Transform Spectrometer (IFTS) for in situ metal additive manufacturing process monitoring. In this Phase I STTR project, Mound Laser & Photonics Center, a developer of laser based additive manufacturing processing, will collaborate with the Air Force Institute of Technology, with expertise and innovative hardware for spectroscopy, to implement the IFTS in a Selective Laser Melting (SLM) R&D test bed to demonstrate advanced strategies for process control and in situ quality assurance such as: (1) automatic detection of the molten area in various layers, (2) in situ release of stresses induced by temperature gradients, and (3) real-time control of alloy composition and minimization of contaminants. These capabilities will facilitate the manufacture of parts with complex geometries with improved microstructures and properties. In Phase I we intend to: (1) prove the utility of the IFTS for monitoring SLM processing of metals and alloys, (2) determine surface temperatures with a statistical accuracy of better than 4 °C, systematic accuracy of better than 10 °C and a dynamic range of up to 2000 °C, and provide rapid (1 kHz), automatic identification of the molten area, (3) track changes in chemical composition due to evaporation, oxidation, and melt expulsion, (4) reduce data dimensionality and correlate these IFTS sensor features with manufacture quality metrics, and (5) design the concept for a Phase II prototype sensor suite that focuses on key aspects of the IFTS datascape to inexpensively emulate the IFTS. In Phase II, a prototype optical sensor will be developed for process control of metallic additive manufacture of lightweight, reliable, low cost structures.

## Primary U.S. Work Locations and Key Partners



In-Process Monitoring of Additive Manufacturing Project Image

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Organizations Performing Work	Role	Type	Location
Advratech LLC	Lead Organization	Industry	Dayton, Ohio
Air Force Institute of Technology	Supporting Organization	US Government	Wright-Patterson AFB, Ohio
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

## Primary U.S. Work Locations

Ohio	Virginia
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## Project Transitions

▶ **July 2014:** Project Start

✓ **December 2014:** Closed out

## Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140639>)

## Images



## Project Image

In-Process Monitoring of Additive Manufacturing Project Image  
(<https://techport.nasa.gov/image/128358>)

## Organizational Responsibility

## Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

## Lead Organization:

Advratech LLC

## Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

## Program Director:

Jason L Kessler

## Program Manager:

Carlos Torrez

## Principal Investigator:

John R Middendorf

## Co-Investigator:

John Middendorf

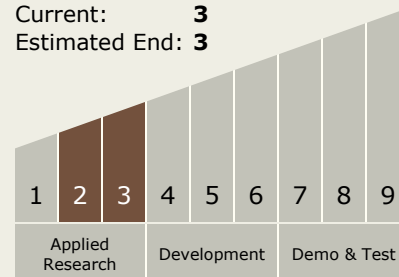
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### Technology Maturity (TRL)

Start: **2**  
Current: **3**  
Estimated End: **3**



### Technology Areas

#### Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - └ TX12.4 Manufacturing
    - └ TX12.4.1 Manufacturing Processes

### Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System